WASTE TONER SYSTEM FOR AN IMAGE FORMING DEVICE

Background

During the image forming process, inefficiencies from the photoconductive member to the media create waste toner. The waste toner should be removed from the photoconductive member to prevent print quality problems. Previous devices have stored the waste toner in an area adjacent to the photoconductive member. Other designs require that the waste toner be moved away from the photoconductive member to a remote area within the device.

The waste removal elements should be constructed to be as small as possible. The overall size of the image forming device may result from the size of the waste removal elements. Larger waste removal elements may require other elements within the device to have increased sizes, such as the imaging unit, media path, and covers. It has further been determined that the overall size of the image forming device is a major purchasing factor for consumers. Smaller devices are preferred because they are easier to handle, and do not require as much space within workspaces. Additionally, the increase in size of these elements may greatly increase the overall cost of the device, as it has been determined that the cost increases as a function of size in more of an exponential rather than linear fashion.

The waste removal elements should also efficiently move the waste toner from the photoconductive members to an area of the machine where it can be stored for removal. This movement may require the waste toner to be moved through different areas of the machine. The movement is made more difficult because the waste toner may move through sections of the machine that are removable from the image forming device. The waste removal elements should be designed to account for sections of the waste toner path being removed, and still prevent toner leakage.

Summary

The present invention is directed to a waste toner removal system for an image forming device. The invention includes a mechanism for removing the waste toner from the cartridge and transporting it through a toner chute to a waste toner tank. One or more actuators within the device allow for the connection between the various elements to seal the waste toner path and prevent toner leakage.

Brief Description of the Drawings

Figure 1 is a partial cut-away perspective view of a section of the waste toner system according to one embodiment of the present invention;

Figure 2 is a schematic view of a cartridge according to one embodiment of the present invention;

Figure 3 is a partial perspective view of the cartridge and waste toner port according to one embodiment of the present invention;

Figure 4 is a partial front perspective view of the waste toner chute with the door in an open orientation according to one embodiment of the present invention;

Figure 5 is a partial front perspective view of the waste toner chute with the door in a closed orientation according to one embodiment of the present invention;

Figure 6 is a partial rear perspective view of the cartridge mounted to the waste toner chute with the waste toner port in a closed orientation according to one embodiment of the present invention;

Figure 7 is a partial rear perspective view of the cartridge mounted to the waste toner chute with the waste toner port in an open orientation according to one embodiment of the present invention;

Figure 8 is a partial perspective view of the waste toner chute connected to a waste toner tank according to one embodiment of the present invention;

Figure 9 is a schematic view of an image forming device constructed according to one embodiment of the present invention;

Figure 10 is a perspective view of first and second covers in an open orientation according to one embodiment of the present invention;

Figure 11 is a partial side view of a second door in a closed orientation; and

Figure 12 is a partial side view of the second door in an open orientation.

Detailed Description

The present invention is directed to a waste toner system within an image forming device as generally illustrated in Figure 1. The system includes a cartridge 20 having an auger for moving waste toner away from a photoconductive member. A waste toner chute 30 (shown in cutaway) is operatively connected with the cartridge 20 to receive the waste toner. The waste toner chute 30 includes an auger 31 for moving the waste toner. An actuator 40 (Figures 6 and 7) is positionable between first and second orientations to control the opening and closing of the cartridge door 27. A waste toner receptacle 80 is positioned at an outlet of the waste toner chute 30 for storing the waste toner. A frame 60 (illustrated in Figures 11 and 12) of the image forming device supports the waste toner system.

Figure 2 illustrates a cross-sectional view of the cartridge 20. The cartridge 20 comprises a developer section 90 and a cleaner section 29. The developer section 90 comprises an exterior housing 91 that forms a reservoir 92 for holding a supply of unused toner. One or more agitating members 93 are positioned within the reservoir 92 for agitating and moving the unused toner towards a toner adder roll 94 and the developer member 95. Unused toner moves from the reservoir 92 via the one or more agitating members 93, to the toner adder roll 94, and finally is distributed to the developer member 95.

The cleaner section 29 comprises an exterior housing 25 and a photoconductive member 23. In one embodiment, the photoconductive member

23 is an aluminum hollow-core drum coated with one or more layers of light-sensitive organic photoconductive materials. A cleaner blade 22 contacts the surface of the photoconductive member 23 to remove residual toner (i.e., waste toner) that remains on the photoconductive member 23. The waste toner is moved to a waste toner auger 21 and transported into the waste toner chute 30.

The cartridge 20 may be constructed of two separate pieces that are positioned together within the image forming device. In one embodiment, the developer section 90 comprises the first piece, and the cleaner section 29 comprises the second piece. One embodiment of a two piece cartridge is disclosed in U.S. Patent Application Serial No. __/_____ Attorney Docket No. 4670-201 entitled "Movable Subunit and Two Piece Cartridge for Use in an Image Forming Device", assigned to Lexmark International, Inc., and herein incorporated by reference in its entirety. In another embodiment, the cartridge 20 is a single piece having a construction similar to laser printer Model Nos. C750 and C752 available from Lexmark International, Inc., of Lexington, Kentucky.

Figure 3 illustrates an end of the cartridge 20 that connects with the toner chute 30 (not illustrated). A waste toner port 26 provides a conduit for the waste toner to exit the cartridge 20 and enter into the waste toner chute 30. A door 27 is movably positioned over the port 26 between open and closed orientations, with Figure 3 illustrating the door 27 in the closed orientation. A handle 28 is connected to the door 27. The handle 28 extends outward from the cartridge 20 and is contacted by the actuator 40 to control the orientation of the door 27 as will be discussed in detail below. A biasing mechanism 121 is positioned between the handle 28 and door 27. The biasing mechanism 121 positions the door 27 in the closed orientation when the cartridge 20 is removed from the waste toner chute 30 to prevent toner leakage. Seals may be positioned on each side of the port 26 to prevent toner leakage when the cartridge 20 is mounted to the waste toner chute 30.

Figures 4 and 5 illustrate a front view of the waste toner chute 30. The waste toner chute 30 includes an inlet 32 for receiving the waste toner from the cartridge 20. A door 33 is positioned adjacent to the inlet 32 and is positionable

between an open orientation as illustrated in Figure 4, and a closed orientation as illustrated in Figure 5. The door 33 is sized to cover the inlet 32 to prevent toner leakage while in the closed orientation. A biasing mechanism 35, such as a spring, is attached to the door 33 to bias it towards the closed orientation. One or more seals 36 may be positioned adjacent to the inlet 32 to prevent toner leakage when the cartridge 20 is mounted to the waste toner chute 30. Door 33 further includes an extension 34 that extends outward from one side adjacent to the actuator 40.

A cartridge door actuator 40 is movably mounted to the frame 60 (illustrated in Figures 11 and 12) between a first orientation as illustrated in Figure 4, and a second orientation as illustrated in Figure 5. In one embodiment, attachments 41 such as screws fixedly connect the cartridge door actuator 40 to a waste toner chute door actuator 45. A catch 42 in the actuator 40 is sized to receive the handle 28 to control the orientation of the cartridge door 27. In one embodiment, catch 42 is substantially a C-shaped opening having a back wall and two opposing walls. The handle 28 fits within the open side when the cartridge is mounted to the image forming device. Actuator 45 includes a contact section 43 that contacts the extension 34 on the waste toner chute door 33. In one embodiment as illustrated in Figures 4 and 5, contact section 43 comprises an edge of the actuator 45. When the actuator 45 is in the first orientation as illustrated in Figure 4, contact section 43 abuts against the extension 34 to open the door 33. When the actuator 45 is in the second orientation as illustrated in Figure 5, contact section 43 is distanced from the extension 34 and the biasing mechanism 35 forces the door 33 to the closed position.

Figures 6 and 7 illustrate a rear view of the cartridge 20 mounted to the waste toner chute 30. In these Figures, a section of the waste toner chute 30 and actuator 45 has been removed for clarity to permit viewing of the interior of the chute and the connection between the waste toner chute 30 and cartridge 20. In Figure 6, the cartridge 20 is positioned with the port 26 aligned with the inlet 32 of the waste toner chute 30. The actuator 40 is in the first orientation and the door 27 is positioned across the port 26. With the actuator 45 in the first

orientation when the cartridge 20 is mounted, door 33 on the waste toner chute 30 is maintained in the open orientation (as illustrated in Figure 4). The cartridge 20 blocks the door 33 in the open orientation, even when the actuator 45 moves to the second orientation. Seals on the cartridge 20 and waste toner chute 30 extend around the connection of the port 26 and inlet 32 to prevent toner leakage. Once mounted, the cartridge handle 28 is positioned within the actuator catch 42.

Figure 7 illustrates the cartridge door 27 in the open orientation to expose the waste toner port 26. The actuator 40 has been moved in the direction indicated by arrow A to the second orientation and the door 27 has rotated away from the port 26. Waste toner moving along the cartridge 20 by the auger 21 is moved through the port 26 and into the waste toner chute 30.

Auger 31 extends along the waste toner chute 30 to move the toner towards the waste toner tank 80. In one embodiment, auger 31 is a helically-shaped wire. It is understood that various other auger embodiments may also be used for moving the waste toner along the waste toner chute 30. A flap member 38 may be positioned within the waste toner chute 30 to prevent toner clogging. The flap member 38 may be a piece of stiff plastic film attached in the throat of the chute 30 between the inlet 32 and the auger 31. A top edge of the flap member 38 is mounted adjacent to the inlet 32, and a bottom edge extends into the path of the auger 31. During operation, the rotation of the auger 31 catches the bottom edge and deflects the member 38 downward. Auger 31 continues to deflect downward until it snaps back upward towards its original position. The deflection and snap create motion to break up any bridged waste toner that may be clogging within the throat.

The waste toner box 80 is positioned at an end of the waste toner chute 30. Preferably, the waste toner chute 30 is vertically positioned with the box 80 at a lower end to allow for gravity to assist in the waste toner movement. The waste toner box 80 is sized to accommodate waste toner from a plurality of cartridges 20 mounted along the waste toner chute 30. In one embodiment, four separate cartridges input waste toner into the waste toner chute 30 and the

waste toner box 80. The waste toner box 80 may be removable from the image forming device, and should be removably mounted to the waste toner chute 30. A shutter 81 positioned adjacent to the lower end closes the waste toner chute 30 when the waste toner box 80 is removed from the image forming device. A biasing member 83 moves the shutter 81 to the closed orientation when the box 80 is removed. A seal 82 on the shutter 81 contacts the waste toner chute 30 to create a compliant connection to prevent toner leakage.

Figure 9 depicts a representative image forming device, such as a printer, indicated generally by the numeral 110. A media tray 140 with a pick mechanism 160, or a manual input 320, are conduits for introducing media sheets in the device 110. The media tray 140 is preferably removable for refilling, and located on a lower section of the device 110.

Media sheets are moved from the input and fed into a primary media path. One or more registration rollers disposed along the media path aligns the print media and precisely controls its further movement along the media path. A media transport belt 200 forms a section of the media path for moving the media sheets past the plurality of cartridges 20. Color printers typically include four cartridges for printing with cyan, magenta, yellow, and black toner to produce a four-color image on the media sheet.

An imaging device 220 forms an electrical charge on a photoconductive member within the cartridges 20 as part of the image formation process. The media sheet with loose toner is then moved through a fuser 240 that adheres the toner to the media sheet. Exit rollers 260 rotate in a forward or a reverse direction to move the media sheet to an output tray 280 or a duplex path 300. The duplex path 300 directs the inverted media sheet back through the image formation process for forming an image on a second side of the media sheet.

The waste toner chute 30 is sized to accommodate each of the cartridges 20. In one embodiment, the waste toner chute 30 is vertically aligned with each of the cartridges 20 connecting at a different vertical position. The inlets 32 are laterally offset from a center part of the chute 30. Further, member 38 acts as a

guide to move the toner away from the inlets 32 and towards the center part of the chute 30 where it is moved by the auger 31.

Toner leakage is further prevented by closing the toner chute doors 33 when the cartridge 20 is not mounted within the image forming device 110. This is especially important when a vertically higher cartridge is connected to the chute 30 and a lower connection is not occupied by a cartridge 20. Toner leakage may occur if the door 33 of the lower connection remained open while the vertically higher cartridge was moving toner into the chute 30. One embodiment of operating with fewer than a full set of cartridges occurs when the color cartridges (i.e., magenta, yellow, and cyan) are removed during monochromatic image formation and the image forming process operates with only the black cartridge.

Figure 10 illustrates an external view of the image forming device 110 having a first door 190 and a second door 191. First door 190 is pivotally connected to the device and mounts the cleaner units 29 as the developer sections are mounted within the main body of the device 110. The first door 190 moves adjacent to the main body and mounts the cleaner units 29 such that each of the waste toner ports 26 is aligned with the corresponding inlet 32 of the waste toner chute 30.

Second door 191 extends over the first door 190 when both are in the closed orientation. Second door 191 is operatively connected to the actuator 40. Movement of the second door 191 between open and closed orientations moves the actuators 40, 45 between the first and second orientations. In the open position as illustrated in Figure 10, actuators 40, 45 are in the first orientation as illustrated in Figure 4 and the door 33 to each inlet on the toner chute 30 is open. After the first door 190 is closed and the second door 191 remains open, cartridges 20 are positioned with the waste toner ports 26 aligned with the inlets 32 as illustrated in Figure 6. The second door 191 is then closed which moves the actuators 40, 45 to the second orientation as illustrated in Figure 7 thus opening the doors 27 to the waste toner ports 26. For connections where

cartridges 20 are not located, closing the second door 191 causes the corresponding waste toner door 33 to close as illustrated in Figure 5.

Figures 11 and 12 illustrate the second door 191 being operatively connected to the actuator 45 and the fixedly attached actuator 40. A link 52 and link arm 53 extend between the second door 191 and the camshaft 51. The link arm 53 and camshaft 51 are fixedly attached to camshaft 51 which is constrained to rotate about its longitudinal axis. Figure 12 illustrates the second door open and the actuators 40, 45 in the downward orientation (as illustrated in Figure 4). Figure 11 illustrates the second door 191 closed and the actuators 40, 45 in the upward orientation (as illustrated in Figure 5). The upward orientation (i.e., second orientation) closes each of the waste toner chute doors 33 where no cartridges 20 are mounted. Movement of the second door 191 from the open to closed positions causes the pivotal connection point 55 between the link 52 and link arm 53 to rotate downward. Camshaft 51 transforms the rotary motion of the link 52 and link arm 53 to linear motion thus moving the actuator 45 and connected actuator 40 upward relative to the frame 60.

The term "image forming device" and the like is used generally herein as a device that produces images on a media sheet. Examples include but are not limited to a laser printer, ink-jet printer, fax machine, copier, and a multi-functional machine. One example of an image forming device is Model No. C750 referenced above.

The term "imaging device" refers to a device that arranges an electrical charge on the photoconductive element 23. Various imaging devices may be used such as a laser printhead and a LED printhead.

A transport belt 200 is illustrated in the embodiments for moving the media sheets past the cartridges 20, and as part of the subunit. In another embodiment, roller pairs are spaced along the media path. The roller pairs move the media sheets past the cartridges 20.

The present invention may be carried out in other specific ways than those herein set forth without departing from the scope and essential characteristics of the invention. The cleaner section 29 may also include a charger 24 that applies

an electrical charge to the photoconductive member 23 to receive an electrostatic latent image from the imaging device. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.